SB612
.A2
U5
1951

Preliminary report on control of undesirable plants on range lands

RR (G)
REVEGETATION
Range Reseeding Committee

LIBRARY
PACIFIC NORTHWEST FOREST AND RANGE
EXPERIMENT STATION
PORTLAND 5, OREGON

June 25, 1951

PRELIMINARY REPORT ON CONTROL OF UNDESIRABLE PLANTS ON RANGE LANDS

U. S. Department of Agriculture
Forest Service
Range Reseeding Committee

The control of undesirable plants on western ranges is one of the most pressing range management problems. New developments, especially the use of chemicals have stimulated activity in this field of range improvement. Each year considerable time and money are spent in clearing large acreages. To help do a better job on control of undesirable plants, the Range Reseeding Committee has assembled the information on the best known methods of control of some of the more common undesirable species.

This present report is intended as a current summary of information on control of undesirable plants. The report is not final and will be revised as needed. Future revisions may include additional species, new methods and materials, and other subjects to make the report more complete.

The killing of undesirable plants should be followed by good management, and it is usually necessary to follow with reseeding to good perennial plants. Otherwise, the treated area is often left bare to erosion, and undesirable plants will soon reinfest the area. Good grazing management must also follow reseeding or the reseeded plants will be killed out. Thus control of undesirable plants, reseeding, and good grazing management all work together for range improvement.

It has not been possible either to include all major undesirable species or to complete an intensive survey of all work done on the species which were selected. The 13 species listed below were selected as plants which are problems over wide areas. Other species may be just as important, but they are often localized in area or information is not available for a write-up.

Although most of the present information was obtained from the Forest Service, the Committee has drawn freely on the work of other agencies and individuals. The Committee thanks all agencies and individuals who supplied information for this report. Results of studies given here, unless appearing in one of the publications listed at the end of each report or in other publications, should not be published by others than the individual or group doing the work. A brief write-up follows for each plant listed below:

1. Big sagebrush (chemical control only--includes statement on black and low sagebrush).
2. Silver sagebrush (chemical control only).
3. Rabbitbrush - tall.
4. Rabbitbrush - small.
5. Juniper.
6. Mesquite.
7. Tarweed
8. Halogeton.
9. Sneezeweed.
10. Tall larkspur.
11. Wyethia.
12. False hellebore
13. St. Johnswort

Those wishing more information about the details of the studies or the results should contact the group that conducted the work.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

1 - BIG SAGEBRUSH (ARTEMISIA TRIDENTATA)

Big sagebrush is a troublesome plant on western ranges; despite the fact that it does not normally sprout, is sensitive to fire, and so brittle that it is easily killed by mechanical breakage. Since control by burning and mechanical methods has been reported in other publications, this report will cover only chemical control of big sagebrush.

Locations tested and methods used. The California Station used different rates and types of 2,4-D and carriers for 3 years. The Intermountain Station used different types and rates of 2,4-D and mixtures of 2,4-D and 2,4,5-T and different carriers at three locations. Region 2 used 2,4-D and 2,4,5-T and a mixture in 1949. The Rocky Mountain Station used different types and rates of contact sprays, 2,4-D, 2,4,5-T, mixtures, and carriers by ground and air at two locations for 2 years (most of this work was in cooperation with the Bureau of Land Management). Colorado A & M College conducted much the same study, except that contact sprays were omitted. The Southwestern Station used different types and rates of 2,4-D, 2,4,5-T, and carriers at two dates by ground and air. Factors for consideration as the result of this work are discussed below:

Stage of plant development is one of the most important factors affecting the kill of sagebrush plants. Plants should be growing actively with leaves one-fourth to three-fourths developed, twigs about half grown, and no flower-stalks showing. One report stated that junegrass and Sandberg and similar bluegrasses should be headed out; wheatgrasses should be in boot with heads showing but not fully headed out. Optimum dates vary with latitude, elevation, and seasonal development. In the central portions (northern Utah and Colorado), May 1 to May 30 is usually best below 7,000 feet elevation, and June 1 to June 15 best above 7,000 feet, dependent upon seasonal development that year. There was some indication that slightly earlier dates might be better for 2,4,5-T.

Type of chemical which gave the best results varied with location. In general, 2,4,5-T was best, followed closely by 2,4-D or a mixture of the two. The ester forms were better than the amine or sodium salts. The higher-order esters (butyl or above) seemed better than the lower-order esters. Physiologists say that the higher the ester, the greater the penetration. As penetration is important in woody plants, substances which will increase the penetration will undoubtedly improve the effectiveness of 2,4-D. The contact sprays (pentaclorophenol [both alone and mixed with 2,4-D], dinitro-sec-o-butylphenol, and arsenic) gave poor results.

Rate of chemical. The higher the rate of chemical applied, the better the results. In general, it took 2 pounds of acid equivalent per acre to give a satisfactory kill (arbitrarily chosen at 75 percent). There were some indications that 1 pound might also give satisfactory kills if other conditions were right. Although 2,4,5-T usually gave slightly better results it costs approximately $3 per pound as compared to $1 for 2,4-D. Using slightly more 2,4-D should give the same kill at a much lower cost.

Two reports suggested that sagebrush was harder to kill during drought years and that more chemical should be used in a dry year.

Type of carrier. Oil was generally better than water, although on the optimum dates water appeared to be as good as oil. Oil-water mixtures were not generally satisfactory but this may have been the failure to use an emulsifier.

Rate of carrier. The higher the rate of carrier the better the results was often stated, but there were so many contradictions it is suspected that complete coverage of the plant is more important than the amount of carrier. Although the trend is toward 5 gallons of oil and 20 to 50 gallons of water, as low as 3 gallons of oil and 5 gallons of water have given satisfactory results. The availability of water and the method of application are determining factors in the type and amount of carrier.

Age of plants. Two reports showed no difference in effect on plants of different ages. This seems generally true.

Method of application. There were no direct tests on method of application, but little difference can be seen between ground rigs and airplane application, as long as application is carefully done. Assuming large areas and a close landing field, airplane application (without chemicals) costs 50 to 75 cents per acre, as compared to $1.50 per acre for ground spraying. With any method, complete plant coverage seems to be a necessity. Sagebrush plants apparently do not translocate spray material radially. Portions of plants missed in 1946 sprayings in Colorado are still alive today and rapidly enlarging on otherwise dead plants. For this reason all figures cited are on the percent of plants completely dead.

Summary and recommendations. Chemical control of big sagebrush offers considerable promise, but basic studies are needed before over-all recommendations can be made. In addition to better types of chemicals and methods of application, we need to know the long-time effect of chemicals upon associated vegetation, and upon the livestock and the game dependent upon this vegetation and area.

Chemical spraying will undoubtedly find its best use in killing sagebrush either on ranges where there are good but supressed understory stands of native grass to thicken up and replace dead brush, or on reseeded areas which have been invaded by sagebrush. Except where sagebrush is low and thin, it is not likely to be useful to kill brush for reseeding because the dead standing brush is still a problem for reseeding machinery.

Cost is also a factor. Assuming 2 pounds of 2,4-D applied by airplane, this is $2.75 per acre for an approximate 75-percent brush kill as compared to $3.50 per acre for the Brushland plow with a 95-percent brush kill and a good seedbed.

Publications:

Cornelius, Donald R. and Graham, Charles A. Selective herbicides for improving California forest ranges. Jour. Range Management 4(2):95-100. March 1951.

Hervey, D. F. Kill that sage! Record Stockman, Annual Edition 59(52):164-7. December 1948.

Hull, A. C. Jr., and Vaughn, W. T. Controlling big sagebrush with 2,4-D and other chemicals. Jour. Range Management 4 (3):158-164. May 1951.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

2 - BLACK SAGEBRUSH (ARTEMISIA NOVA)

Black sagebrush was two or three times more susceptible to injury from 2,4-D than big sagebrush in Intermountain and Rocky Mountain Station tests. Black sagebrush is a valuable forage plant for livestock and big game on winter ranges. For this reason, chemical spraying should proceed with caution on areas of black sagebrush.

- LOW SAGEBRUSH (ARTEMISIA ARBUSCULA)

Low sagebrush sprayed by the California Station showed much the same reaction to chemicals as did big sagebrush.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

3 - SILVER SAGEBRUSH (ARTEMISIA CANA)

Silver sagebrush usually occurs in the upper sagebrush zone. It occupies the moister sites and is common on soils of heavier texture and on poorly drained areas. Silver sagebrush seldom grows more than 3 feet in height and the stems are small and pliable. Unlike big sagebrush, they do not break easily. Railing is of little value and plowing must be deeper and more carefully done than for big sagebrush. Because silver sagebrush sprouts from the crown, it is not killed by fire. This report deals with chemical control only.

Locations tested and methods used. The California Station tested different rates and dates of spraying 2,4-D and 2,4,5-T for 3 years. The Rocky Mountain Station sprayed some silver sagebrush on one airplane plot in 1950.

Chemical treatments and results. At the California Station, silver sagebrush responded to the same chemicals and rates as did big sagebrush, but was generally harder to kill. In the one Rocky Mountain Station plot, defoliation the year of spraying was greater for silver sagebrush than for big sagebrush. Optimum date of spraying appears to be about a month later than for big sagebrush.

Summary and recommendations. It appears that silver sagebrush will respond to much the same treatment as big sagebrush. It is recommended that the most effort be put into control of big sagebrush. When suitable methods are discovered, these methods can then be tested on silver sagebrush.

Throughout much of the west, silver sagebrush grows on good soils where there is a good grass understory. If chemical control proves practicable, there is a possibility for great improvement of silver sagebrush lands through chemical spraying.

Publications:

Cornelius, Donald R. and Graham, Charles A. Selective herbicides for improving California forest ranges. Jour. Range Management 4(2):95-100. March 1951.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee June 25, 1951

4 - BIG RABBITBRUSH (CHRYSOTHAMNUS NAUSEOSUS AND RELATED SPECIES)

Big or rubber rabbitbrush is a member of the composite family. It spreads rapidly by a heavy seed crop and also by root sprouts. It is now taking over many areas which were originally sagebrush. Fire seldom kills big rabbitbrush and when burned down, it not only sprouts from the crown but from the roots at some distance from the crown. Any mechanical method of control must get below the sprouting roots and chemical control must kill the parent plant and prevent the roots from sprouting. Control of this plant appears more difficult than control of big sagebrush.

The results reported in this discussion are mainly where rabbitbrush happened to occur on areas which were treated for control of sagebrush.

Locations tested and methods used. The Pacific Northwest Station reported on spraying and mechanical control by the forests and the Bureau of Land Management. The Intermountain Station tested several types and rates of chemical at two locations. The Rocky Mountain Station reported on mechanical control. Colorado A & M College tested several types and rates of chemicals and carriers and several dates at two locations for 2 years.

Mechanical treatments and results. Plowing with the Brushland plow, wheatland-type plows, heavy offset disks, or any machine set to cut at least 4 inches and preferably 6 inches deep is reported as doing a good job of killing big rabbitbrush in some areas. On other areas, deep and careful plowing has resulted in root sprouting and poor kills. The Pacific Northwest Station reports that plowing twice, once in the spring and again in the fall, is needed for effective mechanical control in that area. Mowing has not been successful but has been tried at only one season.

Chemical treatments and results. The Pacific Northwest Station reports that effective reduction seems possible between June 20 and August 1 at around 2 pounds per acre. They also report that the best season for chemical kills is probably later than for sagebrush. The Intermountain Station had 13 direct comparisons between big sagebrush and rabbitbrush with 2,4-D and 2,4,5-T ranging from 3/4 to 6.4 pounds per acre. Although all kills were low, the kill of rabbitbrush was higher than the kill of sagebrush. They feel that 1 pound of 2,4-D per acre might give effective control.

Summary and recommendations. The best method of control on some areas appears to be plowing 4 to 6 inches deep with the Brushland plow, wheatland-type plow, or heavy offset disks. Where one plowing once will not kill rabbitbrush, it may be necessary to plow deeper or to plow twice, once in the spring and once in late summer. One station indicated that poor kills from plowing might be attributed to season of plowing. If this is the case, studies are needed on dates of plowing. More attention should be given to all phases of control of this aggressive plant.

Chemical control has been tried and although it offers considerable promise, more work is needed. For those who try chemicals, it might be well to try 1 to 2 pounds of 2,4-D or 2,4,5-T per acre in late spring or early summer.

(NOT FOR PUBLICATION)

RR - (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

5 - SMALL RABBITBRUSH (CHRYSOTHAMNUS VISCIDIFLORUS TORTIFOLIUS AND RELATED SPECIES)

Small rabbitbrush occurs over a wide range. It seldom occurs in pure stands but is usually associated with sagebrush and other species. It is a small plant but has much the same growth characteristics as big rabbitbrush. Most workers feel that control will be more difficult than for big rabbitbrush. Suggestions for control of big rabbitbrush also apply to small rabbitbrush.

Locations tested and methods used. The California Station tried several chemicals over a 2-year period. The Pacific Northwest and Rocky Mountain Stations reported on chemical and mechanical control.

Mechanical treatments and results. Plowing to a depth of 4 to 6 inches has been the only method reported and seems to be satisfactory in some areas. The Pacific Northwest Station reports that it is a tougher problem than big rabbitbrush.

Chemical treatments and results. California Station work shows that small rabbitbrush is susceptible to chemicals but will undoubtedly require heavier concentrations than will sagebrush. The Pacific Northwest Station reports that small rabbitbrush is less susceptible to chemicals and sprouts more readily from the crown and the roots than does big rabbitbrush. Spraying with several types and rates of chemicals and carriers at three dates in Colorado and Wyoming which killed up to 97 percent of the sagebrush had little effect upon little rabbitbrush. Some plants were killed but the remainder grew more vigorously to take their places.

Summary and recommendations. The best method of control is plowing to a depth of 4 to 6 inches or more with the Brushland plow, wheatland-type plows, heavy offset disks, etc. Where this is not satisfactory, it may be that plowing deeper, plowing twice, or plowing at some other season will give better results.

Further work may show chemicals to have promise but results to date are unsatisfactory.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

6 - JUNIPER (Juniperus spp.)

The problem of juniper control is widespread and pressing. Juniper in western United States occupies approximately 76 million acres. Though much of this represents a natural woodland type, many former excellent grassland ranges are also being rapidly overrun by various species of juniper. Where the juniper has invaded the grasslands, the carrying capacity is decreased and handling of livestock is made more difficult. More serious still, juniper uses more water and is less effective as a soil stabilizer than the grass it replaces.

Source of information.--The Southwestern Forest and Range Experiment Station in the late 1930's and early 1940's tested sodium arsenite on juniper. More recently they have conducted other limited trials, mainly involving the use of chemicals for control of Utah juniper, in central Arizona. Practical juniper control, mostly by mechanical means, has been undertaken by individual ranchers, State and Federal agencies throughout the Southwest. The information presented was obtained from this work and from a comprehensive paper on Texas junipers by Wolff (Wolff, Simon E. An evaluation of some weedy Texas juniper. SCS, Ft. Worth, Texas, Nov. 1948.)

Mechanical treatments.--Destruction of the tops by cutting at the ground line, lopping of all green limbs, or thorough burning will kill nonsprouting species such as Utah, oneseed, and Ashe juniper. For scattered stands of young or small trees, chopping is undoubtedly the cheapest and most effective control method. Ranchers in central Arizona have reported costs as low as $1.50 per acre.

Some common southwestern species, such as alligator and redberry juniper, sprout profusely unless destroyed below the soil line. On these sprouting species, mechanical kill can be effected only by uprooting the plants. The bulldozer or its modifications, such as the "cedar bit," "stinger," and the "tree scoop," is best adapted for use on uneven-aged stands with a moderate number of trees. The chief advantages of this method are: (1) It can be used on slopes and among large rocks, (2) the work can be done by one man at convenient periods, (3) it does a clean job, and (4) less power is needed than for cabling. Costs vary with the abundance and size of the trees, and range from $1.75 to $15.00 or more per acre.

"Cabling" and "chaining" are best adapted to large level or gently sloping areas free from surface boulders and with moderate stands of medium sized trees. Their chief advantages are speed and low costs. Coverages as great as 50 to 60 acres per hour of tractor operation have been obtained. Reported costs vary from less than 75 cents to $2.50 per acre. Cabling is never 100 percent effective and a follow-up with a "dozer" or "stinger" may be necessary to lift out the trees not uprooted by the cabling process. This obviously increases the total cost of control. Cabling is not suited to small trees which are flexible enough to bend under the cable or large trees 10 inches and more in diameter.

Hand grubbing of scattered young trees as soon as they can be seen is an effective and practical method for preventing the invasion of grassland by either the sprouting or nonsprouting forms of juniper. In Texas, burning with a pear burner has also been used as a quick, effective way to eradicate thick, even-aged stands of small seedlings.

Frequently, it is advantageous to use a combination of more than one method to eradicate juniper. Thus cabling and "dozing" must usually be combined to obtain a clean job. In an uneven-aged stand, a combination of "dozing" the large trees and chopping or grubbing the small ones is sometimes most economical.

Chemical treatment.--Only a limited amount of preliminary information is available on chemical eradication of juniper. Utah juniper has not proved susceptible to basal pours of any herbicidal oil, chemical, or combination of these two except sodium arsenite. Utah and oneseed juniper can both be killed with sodium arsenite. One method for its use is to completely girdle the tree and apply sodium arsenite in the girdle with an ordinary oil can. A gallon of water solution containing 2-2/3 pounds of arsenic trioxide equivalent was found to be enough to treat 80 trees effectively. A pour of one pint of arsenic solution in a small basin around the bottom of the tree also proved satisfactory. A concentration of 1 pound arsenic trioxide equivalent per gallon of water solution is needed for this method. Sodium arsenite appears most practical for work on large scattered individual trees. Foliage sprays with some of the new hormone type herbicides have given promising but erratic results. Kills have been obtained with 2,4-D, 2,4,5-T, and TCA, but the lower limits in concentrations and volumes have not yet been determined. More work also needs to be done on the carriers.

(NOT FOR PUBLICATION)

RR - (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

7 - MESQUITE (PROSOPIS JULIFLORA)

Control of mesquite poses a major problem on large areas of range land in Texas, New Mexico, and Arizona. Mesquites reduce grazing capacity and handicap the handling of livestock. Moreover, they use more water and are less effective than grass in stabilizing soil.

Source of information.--The information presented is based on detailed research done by the Southwestern Forest and Range Experiment Station at the Santa Rita Experimental Range. This has been supplemented with the results of control efforts by individual ranchers and published information.

Mechanical treatments.--Effective mesquite kill is obtained only when the dormant sprout buds located on the underground stem are killed or removed. These buds occurring from three to eight inches below the ground level grow rapidly as sprouts whenever injury or destruction of the above ground stem occurs.

For young mesquites in the early stages of invasion, grubbing to a depth of five or six inches below the soil surface is the best control method. Cost of grubbing varies with the density of the stand and with the moisture content and type of soil.

In dense stands of mesquite, partial control can be obtained by "cabling" or "chaining." Costs as low as 50 cents per acre have been reported. Where a follow-up treatment is made to remove individual plants not uprooted, the costs are increased to from five to fifteen dollars per acre. Much mesquite has been removed by mechanical grubbing with a "dozer" or "stinger," at costs varying from five to twenty dollars per acre depending on the number and size of the trees. The advantages and limitations of these methods are the same as those described for the sprouting species of juniper.

Burning is unsatisfactory as a method for controlling established mesquite stands because most mesquite trees sprout after they are burned.

Chemical treatments.--Killing mesquite with sodium arsenite is effective but dangerous and time consuming. Two methods of application have proved satisfactory; root poisoning in a shallow basin around the bottom of the plant, and stem poisoning applied in a girdle around the bole. Best results from both methods have been obtained during the late fall, winter, and early spring months.

Basal pours of petroleum oils give good kills of mesquite, and are non-poisonous to humans and livestock. Though specially refined herbicidal oils, kerosene, and diesel oil are equally toxic, requiring an average rate of 1 pint per tree for effective kill, diesel oil is the cheapest. Cost of killing mesquite with diesel oil on the Santa Rita Experimental Range in 1949 averaged 4.4 cents per tree.

Good kill is obtained with diesel oil during every month of the year, providing the oil is properly applied and the soil is not wet. The amount of diesel oil required to kill a mature mesquite tree was reduced from one pint to one-half pint by fortifying it with five percent of dibromoethane or 30,000 p.p.m. isopropyl ester of 2,4,5-T.

Basal sprays with diesel oil showed promise of lowering costs for killing mesquite by reducing the required volume and treatment time. Moreover, multiple stemmed mesquite could be treated more effectively with this method than with basal pours. Spraying the bases of mesquite with unfortified diesel oil has produced kills of 55 percent. By adding five percent of the isopropyl ester of 2,4,5-T kills were increased up to 95 percent.

Foliage spraying with selective hormone herbicides has given erratic results. Kills ranging from 0 to 100 percent indicate that mesquite may be killed with the chemicals now available when more information concerning the plant and factors affecting its growth are obtained. So far the ester and amine salt forms of 2,4,5-T applied during April have proved most toxic. Results from airplane spraying of mesquite in the moister parts of Texas are encouraging, but under drier conditions this method of control is less promising.

Control of mesquite by range management.--There is evidence that a good grass cover will retard the establishment of seedlings. Therefore, any management system which improves the vigor and density of the perennial grass cover will slow down the rate of mesquite invasion. Large numbers of mesquite seeds are spread in the droppings of livestock; wherever practical it is desirable to isolate mesquite-infested lands from areas still free of mesquite. In some areas, burying of seeds by kangaroo rats is an important factor in spreading mesquite. Rodent populations increase as the range deteriorates. Hence, any management which increases the grass stand and decreases the rodent population should in turn decrease the establishment of mesquite.

Summary.--The control of mesquite is extremely difficult. Only limited expense may be incurred on most range lands. Large numbers of seeds which remain viable over long periods of time are disseminated by livestock and rodents. Reinfestation on controlled areas by seedlings and sprouts is usually rapid. Furthermore, different control methods must be used with variations in growth form, topography, and differences in soil and climatic conditions.

Publications

Glendening, G. E. Noxious tree and shrub invasion and control in Arizona. Arizona Cattlelog 6 (2):18-21, Oct. 1950.

Fisher, C. E., Young, D. W. Control of mesquite. Cattleman 37 (9): 22-23, 66, 68, Feb. 1951.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

8 - CLUSTER TARWEED (MADIA GLOMERATA)

Tarweed is an annual which germinates early in the spring (even under snowbanks), and grows so vigorously that it prevents establishment of good stands of reseeded grass. It matures seed during late summer and dries up so that during the fall planting season, one is led to believe that tarweed areas are good seeding sites. Past experience has shown that tarweed must be reduced for good stands of reseeded grass.

Locations tested and methods used. The Intermountain and Pacific Northwest Stations reported on mechanical treatment and chemical spraying of tarweed, and the Rocky Mountain Station on chemical spraying.

Mechanical treatments and results. As tarweed is an annual, any treatment which gives shallow but complete cultivation during the growing season will kill the plants. Treatment must be prior to seed maturity to prevent the next crop. Cultivation is best done in the spring when plants are 1 to 2 inches high. This may be followed immediately by spring seeding. The next most effective time is summer cultivation before the tarweed sets seed. If rainfall conditions are right, seeding may follow summer cultivation, but in most areas seeding must wait until early fall. Fall cultivation is not effective.

Chemical treatment and results. The Intermountain Station sprayed at six locations with different rates of 2,4-D in butyl ester and ami forms in 30 gallons of water, both with and without 2 gallons of diesel oil per acre. Three-fourths pound of 2,4-D in either form gave a complete kill when tarweed was in the four-leaf or younger stage. At the four-leaf stage, butyl ester gave the best results, but both resulted in over 90-percent kill which was sufficient reduction to get good stands of reseeded grasses. When plants were in the six- to ten-leaf stage, enough plants survived to prevent establishment of reseeded stands. The addition of diesel oil seemed to make no difference in plant kill. Desirable perennial weeds growing with tarweed were killed back but grew again the next year. The Pacific Northwest Station reports good kills with 1 pound of sodium salt of 2,4-D per acre. A Region 2 forest used 7 and 14 pounds of 2,4-D in 880 gallons of water per acre after tarweed was in bloom. This killed the tarweed, but it was replaced with Collomia which was also a problem.

Summary and recommendations. Tarweed can be effectively killed both by mechanical cultivation and by chemicals. The method to use will depend upon the location and the cost of treating the area. When there are other plants on the area, some type of cultivation will help prepare a good seedbed for reseeding. Where tarweed is near a solid stand it may be that seedbed preparation, other than killing tarweed, is not needed. In such cases good results have been obtained by drilling right in the tarweed stands at the time of spraying in early spring. Further work is needed in chemical spraying of tarweed.

Publications:

Stevenson, E. W. Reseeding tarweed infested ranges. U. S. Forest Service, Pacific Northwest Forest and Range Expt. Sta. Research Note 68, 6 pp., September 1950.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

9 - HALOGETON (HALOGETON GLOMERATUS)

Halogeton is an introduced poisonous annual weed which is widely scattered in Nevada, Utah, and Idaho, and also occurs in Oregon, California, Wyoming and Montana. It occurs mostly in the sagebrush and salt desert shrub types. It grows on most soils but makes its best growth on neutral and saline areas, growing with a pH as high as 8.6. Halogeton is not a vigorous competitor and is apparently unable to spread and grow in damaging amounts where there is a full stand of native vegetation. It has been called nature's answer to land abuse, because it is abundant only where perennial vegetation has been thinned out or destroyed by grazing or mechanical treatments. Halogeton starts growth early in the spring and has much the same season of growth and the same growth habits and growth requirements as Russian thistle. It produces an abundant seed crop in late summer and fall.

Halogeton contains oxalates which are poisonous to both cattle and sheep. It is most dangerous and causes most livestock losses in fall and early winter. It has been highly publicized and control measures are being tried in several states. The control work reported below is mostly from the Intermountain Station and from publications.

Mechanical treatments and reseeding. As Halogeton is a vigorous annual and an abundant seeder, mechanical control is only temporarily successful, unless followed by reseeding. Wherever present or potential Halogeton areas are disturbed by anything such as cultivation or fire, such areas should be immediately reseeded to perennial grasses to prevent the invasion or reinvasion by Halogeton. Throughout the Intermountain Region, Halogeton has been unable to invade established stands of reseeded grass, and grass seedings made in stands of Halogeton have been successful.

Throughout the present range of Halogeton, crested wheatgrass is the best adapted species for reseeding on the better sites. On some of the drier salt desert shrub types, reseeding has been only partially successful. On such areas, Halogeton must be controlled primarily through management.

As Halogeton grows late in the spring and does not offer severe competition to early growing grasses, pure Halogeton areas (or potential areas) with practically no other vegetation may be drilled in the fall. Where there is considerable early growing annual or perennial vegetation mixed with the Halogeton, seedbed preparation such as plowing or burning must precede drilling to crested wheatgrass or other adapted species.

Chemical treatment. Halogeton is easily killed by spraying with 2 pounds of 2,4-D (acid equivalent) per acre in late summer. The Pacific Borax Co. reports that 1 pound of polybor-chlorate spray per 100 square feet will kill Halogeton when the plants are 1 inch in height. This chemical costs 10 cents per pound. Chemical control cannot be recommended for the following reasons: (1) There is usually enough ungerminated seed left to produce a good crop the next year, and (2) Spraying may kill associated annual and perennial plants and thus further denude the area and give more space to grow more Halogeton.

Summary and recommendations. As Halogeton occurs only on depleted and disturbed areas, the best over-all control for this poisonous weed is good management. This will allow good native plants to increase and crowd out Halogeton where it is now present and keep it from coming into areas where it is not present.

Where reseeding is practical, areas of near pure Halogeton can be drilled to crested wheatgrass with no other method of seedbed preparation. Where other vegetation is present, some method of seedbed preparation such as plowing or burning must precede reseeding. All disturbed or depleted areas which might be invaded by Halogeton should be reseeded to prevent this plant from gaining a foothold.

Chemical control is not recommended except as an emergency means for eradicating isolated spots of Halogeton some distance from the major area of this weed.

Publications:

Erickson, L. C., Tisdale E. W., Zappetinni, George and Morton, Howard L. Halogeton--Intermountain range menace. Idaho Agr. Expt. Sta. Circ. 117, Feb. 1951.

Stoddart, L. A., Stewart, George, Markham, Ben and Clegg Howard. Halogeton control recommendations. Utah Section, American Society Range Management. (Mimeographed) 1951.

Stewart, George. Healthy ranges resist Halogeton. Utah Farmer 71:3, Jan. 4, 1951.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

10 - ORANGE SNEEZEWEED (HELENIUM HOOPESI)

Sneezeweed occurs in all western states except Washington and Montana but is most abundant in Colorado. It is a perennial of the composite family. It spreads rapidly with an abundant seed crop. It enlarges the original clump with numerous sprouts from the tap root. Mechanical methods of control must cut 2 to 3 inches deep to get below sprouting of the tap roots.

Locations tested and methods used. Effects of plowing were observed on the Fremont National Forest in Oregon. Cultivation and chemical spraying were tested by the Rocky Mountain Station from 1946 to 1950. Chemical spraying was tested by Region 2 in 1950.

Mechanical treatments and results. On the Fremont National Forest, 90 percent of the sneezeweed was killed by plowing 4 to 6 inches in September with a disk tiller. Date of plowing was considered to be important.

The Rocky Mountain Station killed 90 to 95 percent of the sneezeweed by double disking 4 inches deep with a tandem disk in July before the sneezeweed matured seed. This was followed by seeding. Good stands of reseeded grass kept out sneezeweed but it reinvaded all unseeded areas the first year.

Chemical treatments and results. Chemicals have been tried by the Rocky Mountain Station for several years on three forests in western Colorado. Spraying has been with jeep and hand sprayers. Several types and rates of chemicals and carriers and different dates of spraying have been tested. The pre-bloom stage of plant growth was the best time of application. Four pounds of 2,4-D acid (ester form) in 50 gallons of water per acre applied with a jeep sprayer gave best results, with kills ranging from 85 to 95 percent. Lower concentrations of acid gave poorer results. The ester form of 2,4-D was effective through a wider range or period of plant development than the amine and salt forms of 2,4-D. Water was as good as distillate as a carrier. Grasses were not damaged, but almost all other associated vegetation was killed or severely damaged.

Cost of treatment. In chemical spraying the jeep can cover 4 acres per hour at a cost of about $8 per acre for both chemicals and application. Plowing or heavy double disking runs from $3 to $8 per acre, with an average of $5.

Summary and recommendations. Sneezeweed occurs over a wide range but causes serious death losses only when it is grazed heavily. Losses commonly occur when infested ranges are grazed too early in the spring or late in the fall when there are not sufficient palatable plants

available for sheep. It is mostly a management problem and losses can be avoided by following the recommendations made in USDA Circular 691 "Management of Sheep on Range Infested with Orange Sneezeweed" by Doran and Cassady, January 1944.

When sneezeweed does occur in dense stands in parks and openings, it can be controlled with chemicals or by cultivation. Both of these operations must be followed by reseeding or sneezeweed will speedily reinfest the area. A good stand of reseeded grass will apparently keep sneezeweed reinvasion to a minimum.

Cultivation costs less than chemicals, removes weedy grasses, provides a good seedbed, and is usually to be preferred to chemicals for sneezeweed control. Cultivation should thoroughly cover the area and should be at least 3 inches deep to get below the possible root sprouts. It can be in the late spring or early summer before seed is mature.

When there is enough sneezeweed to be a major problem, there is generally not enough desirable grass to spread and take over if the sneezeweed is killed by spraying. Where native grasses are present, they increase greatly in yield following release from sneezeweed competition. Sprayed areas do not have as good a seedbed as cultivated areas, thus the reseeded plants develop more slowly and there is danger of sneezeweed invasion before the reseeded plants become well established. Spraying may offer promise in rocky or inaccessible areas where cultivation is not practicable.

Publications

Doran, Clyde W. Control of orange sneezeweed with 2,4-D. Jour. Range Management 4(1):11-15, 1951.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

11 - TALL LARKSPUR (DELPHINIUM SPP.)

Tall larkspur is a deep-rooted perennial which occurs throughout the west. It is poisonous to cattle but does not affect sheep. It usually occurs on areas where mechanical eradication, except grubbing, is impossible or extremely costly. For this reason much attention has been given to chemical control.

Locations tested and methods used. The Pacific Northwest and the Rocky Mountain Stations report exploratory chemical spraying of larkspur. Region 1 reported spraying larkspur with 2,4-D. Region 2 reported two grubbing and two chemical sprayings of larkspur.

Mechanical control. Tall larkspur usually occurs in small patches and in inaccessible areas so that grubbing is often the only practicable method of mechanical control. Although this is expensive it is satisfactory because it does not take the loss of many cows to pay for hand grubbing of small patches. Region 2 reports that grubbing is economically feasible.

Chemical treatments and results. The Pacific Northwest Station sprayed larkspur just as it was beginning to bloom. There was some distortion but no kill. Region 1 showed light kills regardless of concentration. Region 2 reported no effect on larkspur from 2,4-D at two places in Colorado and a stimulation of growth in Wyoming. The Rocky Mountain Station sprayed in Wyoming with 2,4-D at from 1½ to 6 pounds per acre in either 15 gallons of water or diesel oil, and 3 pounds of ACP 1054 (one-third 2,4,5-T and two-thirds 2,4-D) in 15 gallons of diesel oil. All caused distortion and the latter caused a 50-percent reduction in foliage and a 20-percent kill. Spraying was just as flowerstalks were beginning to elongate. Scattered plants of big sagebrush surrounding the plots were completely killed with the drift of spray.

The University of Wyoming has been treating larkspur for 3 years. They recommend 3 pounds of 2,4-D applied when the plants are about 6 inches tall to get a 35- to 50-percent kill the first year. Respraying the second year with the same amount of chemical will give from 60- to 75-percent kill and respraying the third year should bring the kill to 95 percent.

Summary and recommendations. Based on work to date, it appears that a combination of good range management and grubbing of small patches is the best method of controlling larkspur. In some areas it may be possible to run sheep through the area to eat the larkspur before the cattle come on the range.

With the development of new chemicals, it is entirely possible that chemical control of larkspur may become feasible. Even if the cost is high on an acre basis the small area covered with larkspur plants might make control feasible.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

12 - WYETHIA (WYETHIA AMPLEXICAULIS AND HELIANTHOIDES)

Wyethia is a native plant used to a limited extent by livestock and big game for forage, especially while flowering. It is not a desirable forage plant because of general low palatability. It is aggressive and takes over on certain soil types that should be producing a high yield of much more palatable forage. The tap root is deep and strong, but reproduction comes entirely from seed.

Chemical treatment. Mules-ear wyethia is susceptible to 2,4-D. The Intermountain Station reports 95 percent decrease in wyethia by use of ethyl ester form of 2,4-D, 2 pounds per acre applied at "half bloom" stage. Two pounds acid equivalent of 2,4-D per acre gave better control of wyethia than 1 pound. Creosote and diesel oil, ammonium sulfamate, and kerosene were not effective in killing wyethia.

The University of Wyoming reports 95 percent kill of wyethia with 2 pounds of 2,4-D per acre. One pound of either the ester or the amine form gave better than 50 percent control. Results with 2,4,5-T were not good. The Northern Rocky Mountain Station reports that 6,000 and 10,000 ppm of Weed-No-More (40 percent butyl ester of 2,4-D) in both water and oil as carriers gave good control of wyethia.

In the Pacific Northwest, spraying with 1 to 2 pounds of sodium salt of 2,4-D per acre in water carrier just before wyethia was in full bloom gave kills of 90 to 95 percent. The spraying cost about $3.00. Spraying leaves the annual weedy competition because many weeds have matured seed prior to date of spraying.

Mechanical treatment. The Pacific Northwest Station killed 95 to 99 percent of the wyethia and secured excellent control of annuals and pussytoes by moldboard plowing in the fall to a depth of 8 inches. This plowing would be limited to rock-free soils and would cost about $5.00 per acre.

Results from the Intermountain Station indicate moldboard plowing, which destroyed about 75 percent of the wyethia, is an effective though expensive means of eliminating wyethia. Disking with wheatland plow or offset disk did not give satisfactory control of wyethia.

Publications

Evanko, A. B. Response of wyethia to 2,4-D. Northern Rocky Mountain Forest and Range Expt. Sta. Research Note 98, 7 pp. April 1951. (Mimeographed).

Mueggler, Walter F. and Blaisdell, James P. Replacing wyethia with desirable forage species. Jour. Range Management 4(3): 143-150. May 1951.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

13 - FALSEHELLEBORE (VERATRUM CALIFORNICUM)

Falsehellebore grows on moist meadow sites. It is usually considered low in palatability and occasionally poisonous to livestock. The plant has heavy rhizomes and has been quite aggressive on many of the meadows in the mountain grazing areas of the western United States.

Location of tests and control methods. Exploratory trials have been made in the Pacific Northwest and this year organized trials have been started on the Wenatchee National Forest. The trials begun this year include the use of 2 and 4 pounds per acre of iso-propyl ester of 2,4-D in 60 gallons of water; 1 and 2 pounds of polybor (a borate compound) per square rod; and 1 and 2 pounds of polybor chlorate per square rod. The 2,4-D was sprayed on the falsehellebore by hand sprayer. The polybor treatments were applied dry to the soil by hand broadcasting.

The Sequoia National Forest in California tried out diesel oil for eradication of falsehellebore from 1937 to 1941. Plants were cut and the oil was poured on the stems of the plants on some plots. On other plots the standing plants were treated by pouring oil down into the funnel-like leaf sheaths.

Results and recommendations. Exploratory trials with spraying, conducted in several places in the Pacific Northwest Region during the last 4 years, have not shown any promise for 2,4-D. Plowing or disking with wheatland plow or heavy offset disk as early as the soil is dry enough and until time of full bloom has given kills of 95 to 99 percent. Plowing or disking prepares ground for drilling. Spraying does not prepare way for seeding.

The work by Ranger Stevenson on the Sequoia National Forest showed that good kill of falsehellebore can be obtained by use of diesel oil. Cutting of the plants before treatment was not beneficial; therefore, wasted effort. Oil can be applied from a regular oil can with spout that will permit oil to flow in a small stream or from a pressure spray gun with the spray disk removed. On thin stands, spraying the whole area results not only in wasting oil but also causes injury to other plants. Individual plants are successfully treated by applying oil to upper leaves so that the surplus will flow into the lower sheaths. On very dense stands, oil might be sprayed broadcast. About the same results were obtained where oil was applied to half-grown or plants fully mature. About blooming time is a desirable time for treatment because the younger plants are up and easily found and may be treated along with the larger plants.

An average of 320 plants can be treated for 1 gallon of oil. Best results were obtained with 27 gravity diesel oil, but lighter oil up to 32 gravity will kill the plants. Approximately 1000 plants can be treated per man-hour when plants are treated individually. No work was done on reseeding at this location because it was considered that grasses and other meadow forage plants would re-establish themselves within a few years.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

14 - ST. JOHNSWORT (HYPERICUM PERFORATUM L.)

St. Johnswort, a native of Europe, occurs on ranges in California, Oregon, Montana, Idaho, and Utah. Over 400,000 acres of grazing lands have been taken over by St. Johnswort in northern California.

This perennial herbaceous weed has a tap root with numerous horizontal branches near the soil surface giving rise to new stems. St. Johnswort is very aggressive where conditions favor its growth. Moderately high rainfall is required and full sunshine preferred. Drier range lands are not invaded.

Although St. Johnswort is poisonous to sheep and cattle, losses are relatively low. The main objection to this aggressive weed is its tendency to crowd out or replace good forage species.

Chemical treatments. Effective although somewhat expensive control has been obtained in California by spreading dry on the soil a mixture of 4 pounds of borax plus 1 pound of sodium chlorate per square rod. This mixture presents much less fire hazard than use of sodium chlorate alone. When used without sodium chlorate, borax should be used at the rate of 4 to 12 pounds per square rod in early spring depending upon density of weed growth. The University of California recommended that treatment should be made sufficiently early in the spring to allow from 8 to 20 inches of rain to leach the chemicals into the soil before the summer dry period begins. The Washington Agricultural Experiment Station has found Borascu, applied at the rate of 4 to 10 pounds per square rod (amount depending on soil and rainfall), to give the cheapest effective treatment used. This treatment was very successful when followed by broadcast seeding of crested wheatgrass or sheep fescue.

In California, the use of 2,4-D has largely replaced the use of borax. According to the University of California report, best results from spraying are obtained with 1½ to 3 pounds of 2,4-D acid per acre. The ester form of 2,4-D has generally given best results. About 20 gallons of water per acre as a carrier has been suitable in early season. In later season, oil carrier has been better than water. The best season for control is the lush-growth period prior to blossoming when plants are 6 to 8 inches high.

The Washington Experiment Station killed the mature weeds with 2,4-D, but new seedling stands of St. Johnswort became established before seeded grasses could gain a foothold. In no case was 2,4-D treatment effective for more than one season.

Biological control. Control of St. Johnswort by use of leaf-feeding beetles offers the greatest promise at present, especially on rather heavy and extensive infestations. Chrysolina gemellata are best adapted west of the

continental divide where autumn rainfall is low. Where precipitation is heavy in autumn, C. hyperici or C. gemellata may be used. The precipitation pattern is much more important than temperature in determining the species of beetle to use. Both kinds of beetles have survived satisfactorily at highest elevations and northernmost latitudes within the range for St. Johnswort distribution in the United States. This information on biological control comes from the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

To obtain beetles it is necessary to cooperate with county and state agencies to conform to quarantine regulations and avoid bringing in undesirable insects and weeds. In California the County Agricultural Commissioner supervises distribution; in Idaho the County Agricultural Agent handles requests for beetles; and in some other states, distribution of beetles is conducted by the Entomology Division of the State Experiment Station. The beetles are collected as newly emerged adults by shaking from the plants in the spring of the year. In the West, this date varies from May through June, depending upon latitude and elevation. About one-half pint, or approximately 5000 beetles, are placed in a one-half gallon paraffin treated food container which is then filled with fresh green leaves of St. Johnswort providing sufficient food for 4 days.

To introduce the beetles into a new field, at least one-half pint should be placed within a 6-foot circle. The beetles should be introduced into a new location as soon after collection as possible. These young adult beetles are not mated and should not be scattered widely over the field or mating may not occur and the colony may not multiply. About 3 years are required on heavy infestation to build up sufficient numbers to begin to get some economic reduction in the St. Johnswort.

Reseeding as follow-up treatment. If range land is tillable from which St. Johnswort has been controlled, then a suitable mixture of perennial forage plants should be seeded as soon as possible. However, it has not proved successful to seed chemically or biologically treated areas without first preparing a seedbed by plowing or disking, firming the soil, and covering the seed. Broadcasting seed on the untilled range land has not given satisfactory results in California, but has met with reasonable success in northern Washington.

Publications

Harris, Grant A. St. Johnswort on western ranges. Northern Rocky Mountain Forest and Range Expt. Sta. Paper 26, 18 pp. Feb. 1951. (Multilithed).

Huffaker, C. B., and Holloway, J. K. Changes in range plant population structure associated with feeding of imported enemies of Klamath weed (Hypericum performatum L.) Ecology 30(2):167-175. 1949.

(NOT FOR PUBLICATION)

RR (G)
REVEGETATION
Range Reseeding Committee

June 25, 1951

EFFECT OF 2,4-D UPON ASSOCIATED PLANTS

Very susceptible	Susceptible	Killed back but little permanent effect	Little or no effect	Desirable plants, effects variable or unknown
	Aster (*Aster foliaceus*)	Aspen	All grasses	Arrowleaf balsamroot
Barberry	Big sagebrush	Astragalus	Eriogonum	Bluebells
Dandelion	Big rabbitbrush	Aster	Juniper	Camas (*Camassia* spp.)
Greaseweed	Bracken fern	Chokecherry	Strawberry	Cinquefoil (*Potentilla gracilens*)
Phlox	Buttercup	Elderberry		Bitterbrush
Winterfat	Cinquefoil	Herbaceous sagebrush		Bud sagebrush
	Currants	Larkspur		Knotweed (*Polygonum bistortoides*)
	Death Camas	Lodgepole pine		Hawksbeard (*Crepis* spp.)
	Geranium	Mesquite		Paintedcup
	Harry goldaster	Oak-brush		Pussytoes
	Lupine	Prickly pear		Mountainmahogany
	Onion, wild	Shrubby cinquefoil		Serviceberry
	Poison ivy	Small rabbitbrush		Snowberry
	Saltbush, fourwing	Spineless horsebrush		
	Salt cedar (tamarix)	Wild rose		
	Thistle, common	Yarrow		
	Trailing fleabane			
	Vetch			
	Water hemlock			
	Willows			